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certain living plant organs, we will publish the results of two series of experiments, one on a 10 per cent. solution of lecithin in m-kresol and the other on the leaf of *Ficus elasticus*. In both experiments the E.M.F. at the junction of these bodies and aqueous solutions of various concentrations was measured.

The differences observed for the same degree of dilution are almost identical in both cases and the drop in potential, if we substitute *m*/10 HCl for *m*/10 KCl, corresponds for a 10 per cent. lecithin solution to the change observed in the case of the intact apple or leaf of *Ficus elasticus* under the same condition.

We obtained similar effects with chemically pure kephalin which Dr. Levene was kind enough to give us, and with triolein, oleic, stearic and palmitic acids dissolved in guaiacol or kresol. The kresol and the guaicol without these lipoids gave concentration effects of a much smaller order of magnitude. Cholesterin gave no concentration effects.

We then made experiments with extracts of the apple in guaiacol and this extract gave the same results as the apple itself.

We may therefore conclude that the concentration effects on the E.M.F. observed in certain plant organs are due to the fact that these organs possess a surface consisting of a phosphatide or some fatty substance. It would be wrong to conclude that the same is true for the surfaces of all cells or organs. In a number of organs, *e. g.*, the striped muscle, the concentration effects are extremly small and it requires further experiments to explain their electromotive behavior.

JACQUES LOEB
R. BEUTNER

THE ROCKEFELLER INSTITUTE
FOR MEDICAL RESEARCH,
April 15, 1913

## METEOR DUST AS A MEASURE OF GEOLOGIC TIME

SOME years ago[1] I suggested a possible method of measuring the rate of formation of strata, and so of geologic time, by the proportion of meteor dust contained in the strata, which method seems, now, to be really practical. Meteorites are continually striking the earth. According to the Britannica, 20,000,000 visible meteorites strike the earth each day and the telescope might reveal twenty times as many. I then assumed that they weighed a gram and were 10 per cent. nickel. This would mean 28.6 grams of nickel per square kilometer, per year. Professor W. H. Pickering has shown reason to believe that the visible meteorites are 15 to 18 cm., or, at any rate, 5 to 7 cm. in diameter,[2] and Farrington[3] finds for the average specific weight 7.8 and for the average per cent. of iron and nickel, in a large number of meteorites, 72.06 and 6.5, respectively. Assume that the invisible meteorites make up for any exaggeration in Pickering's largest figure and that we have 7,300,000,000 meteors, weighing 23,700 grams each, striking the earth in a year, and we would have 340,000 grams per square kilometer of cosmic material per annum, of which 20,000 grams are nickel.

The .001 to .0001 grams per square meter of partly cosmic dust found on a 30-millimeter layer of granular snow by A. E. Nordenskjold,[4] Lat. 80° N., Long. 15° E., might be a small part of the year's accumulation.

The redness of the residual red clay may be due to the cosmic dust slowly added in this slow process. This should also be a large part of the abysmal red clay of the great depths of the ocean. Of this red clay one square kilometer, one meter thick, would make 2,500,000 tons, if the specific gravity is 2.5. It contains, according to Clarke,[5] 0.0077 per cent. more of nickel than the average igneous rock. Assuming the nickel of the

[1] Annual report Michigan Geological Survey, 1901, p. 243.

[2] *Astrophysical Journal*, 1909, p. 378; 1910, p. 89.

[3] Field Museum of Nat. Hist., Pub. 151, pp. 213–14.

[4] *Poggendorff's Annalen*, Bd. 151 (1874), p. 158. See also "Studien und Forschungen veranlasst . . . Norden," von A. E. Nordenskjold, Leipzig, 1885. *Journal f. prakt. Chemie*, N. F., Bd. 9 (1874), pp. 356–67.

[5] Data of Geochemistry, U. S. G. S. Bulletin 330, pp. 490 and 27 (.0307 and .023).

igneous rock to fairly represent the volcanic ash, which is another large part of the abysmal clay, a meter thick would contain 192.5 tons of nickel extra per square kilometer. It would take 8,700 years to accumulate this extra 192.5 tons of nickel in a meter at the rate of 20,000 grams per year. Now the red clay has, certainly, formed very slowly, as shown by the abundance of sharks' teeth and whales' ear bones, as well as the manganese and meteor dust.[6] The man in the world best qualified to guess in an after-dinner conversation expressed to me his guess that 500 feet of the red clay would represent all geologic time. At the above rate, 500 feet, *i. e.*, 152.5 meters, would equal 13,000,000 years. Now this is of the order of the figures of other estimates of the earth's age, suggestively near to other short estimates, when we see that we have taken Pickering's maximum estimate of the size of meteors. If we took Pickering's smaller figures for the size of the meteorites, we could get estimates of age as great as the larger estimates of the age of the earth.

My object, at this time, is to urge the members of the talked-of Arctic and Antarctic expeditions, or, in fact, any one in snowy climates, to complete Nordenskjold's observations by finding the amount of cosmic dust in a large amount of snow, accumulated in a known time, determined by annual rings or otherwise. It may, also, be well to test especially for the amount of nickel in strata which are thought to have formed very slowly.

I have no doubt, also, that within this century, there will be drilled a hole in the bottom of the sea which will give us the other datum to be determined.

Alfred C. Lane

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## *THE MILWAUKEE MEETING OF THE AMERICAN CHEMICAL SOCIETY*

Although the American Chemical Society changed its time of meeting from winter to spring there was no falling off in the attendance at the Milwaukee meeting, for in spite of the distance from many of the local sections some four hundred members gathered for the meeting, as well as thirty guests.

The council meeting was held on Monday evening, March 24, and it was voted that the next meeting should be held in Rochester, New York, early in September. Other business of a general character was considered and the reports of all committees received.

On Tuesday morning the following four papers were given in general session, and with the exception of the last were fully illustrated:

Joel H. Hildebrand: "Some Applications of the Hydrogen Electrode in Instruction, Analysis and Research."

D. M. Buck: "Copper in Steel. The Influence on Corrosion."

H. E. Howe: "Some Projection Experiments with Spectra."

Wilder D. Bancroft: "The Theory of Emulsions."

On Tuesday afternoon excursions were held to the plant of the Jos. Schlitz Brewing Company, to the gas and coke plant; and the works of the Pfister & Vogel Leather Company and the Vilter Manufacturing Company were also open to the members.

In the evening a complimentary smoker was held in the Fern Room of the Hotel Pfister, at which Mayor Bading of Milwaukee was present.

On Wednesday there were meetings at Marquette University of the Agricultural and Food Division, the Biological Chemistry Division, Industrial Chemists and Chemical Engineers, the Pharmaceutical Chemistry Division, the Physical and Inorganic Chemistry Division and the Rubber Section.

On Wednesday evening Professor Julius Stieglitz, of Chicago, gave a public lecture on "Combustion," which was largely attended by the members as well as by the citizens of Milwaukee, probably eight hundred people being present.

On Thursday the meetings of the Divisions continued and the Organic Chemistry and Fertilizer Divisions also met.

In the afternoon excursions were taken to Pabst Brewing Company and the Pfister & Vogel Leather Company and in the evening a subscription dinner was held at the Hotel Pfister.

On Friday seventy-five of the members went by special train to Madison, Wisconsin, where they were received by committees of the Wisconsin Section of the American Chemical Society and con-

[6] *Bull. Mus. Royal*, 1884, p. 35. "Sediment de Mer Profounde."